

# SOME MELALEUCA-FIRE RELATIONSHIPS INCLUDING RECOMMENDATIONS FOR HOMESITE PROTECTION

by

Dale D. Wade  
Research Forester  
Southeastern Forest Experiment Station  
Southern Forest Fire Laboratory  
USDA Forest Service  
Macon, Georgia

**Abstract.** — *Melaleuca quinquenervia*, an introduced tree with high fire tolerance, is displacing native south Florida vegetation on a variety of sites. *Melaleuca* has fire adaptations that enhance the survival of established trees, promote reproduction, and increase fire intensity to the detriment of less fire-resistant competitors. The combined use of fire and herbicides to help control the spread of this species is advocated, and recommendations are given for reducing the potential for destruction of wildland homesites during melaleuca crown fires.

## INTRODUCTION

South Florida is characterized by long sunny days, warm temperatures, and plentiful rainfall, but this combination does not persist throughout the year. Freezing temperatures are recorded annually and a sharp contrast generally exists between the several months of standing water during the rainy season and the "drought" conditions that follow at the height of the dry season. Moreover, the luxuriant plant growth during the wet summer becomes increasingly flammable as the winter dry season progresses. South Florida also has the distinction of being the lightning capital of the Nation. Lightning fires, along with water and periodic freezes, shaped and maintained this vegetative mosaic that endured until the late 1800's.

Since then, large scale drainage projects have lowered the water table to the point where organic soils are now dry enough to burn during most dry seasons. Today, humans cause the vast majority of fires, and losses can assume national importance. For example, total acreage burned during the 5-year period 1974-78 in the seven counties comprising extreme south Florida averaged 98,800 acres per year; the 229,00 acres that burned during the 1974 drought year amounted to 15 percent of the non-federal, protected land that burned in the United States that year.

Thus, for any plant to thrive in the south Florida environment, it must be able to withstand periods of flooding and drought, occasional freezing temperatures, and repeated fire. *Melaleuca* (*Melaleuca quinquenervia*) is such a plant.

Introduced into south Florida early this century, this member of the myrtle family has demonstrated an ability to colonize a wide range of sites. Its reputation as an aggressive plant that replaces the native vegetation is well founded as attested to by the pure stands it eventually forms. There is little doubt that this tree evolved in close association with periodic fire; both its survival and reproductive strategies are directed toward such a regime.

## FIRE ADAPTATIONS

### *Reproductive Behavior*

*Melaleuca* begins flowering at a very early age — as young as 2 to 3 years old according to Meskimen (1962). Unlike most trees, this species blooms profusely several times a year. Moreover, it stores the mature seed in closed capsules that remain attached to the branches. Studies of capsule opening in the related eucalyptus genus showed that capsules open whenever their moisture content drops below about 25 percent (Christensen 1971). This can be caused by the heat of a fire or by formation of an abscission layer that cuts off the sap flow. It then takes several days for the capsules to open so there is no threat of the seeds being exposed and consumed in the fire. The capsules themselves are unlikely to ignite, probably because they are dense woody structures and because crown fires have short residence times. An individual tree can retain millions of seed waiting for release (fortuitous or deliberate). Although natural twig mortality causes the continual

release of a few seed, some of which find suitable microsites for subsequent seedling establishment, melaleuca can more nearly be described as pre-emptive, saturating an area with millions of seed after fire or heavy frost. The invasion of melaleuca into new areas is geared more to a slow inexorable expansion that radiates out from each mother tree rather than to long-distance seed dispersal — this is described in detail by Browder and Schroeder (this symposium) and by Woodall (this symposium).

If seeds are superficially buried in the soil, Woodall<sup>1</sup> found that they can remain viable for at least 10 months while waiting for conditions favorable for germination. When these conditions occur, germination can still stretch out over several months,<sup>1</sup> presumably because of microsite differences and inherent seed variability. If the falling seed lands on surface water, or if the new germinants float loose because of a rapid rise in the water table before their roots can anchor them, they can be transported downstream. Ordinarily, the seed — or germinants — will adhere to any protruding vegetation, which limits their downstream voyage; but if seed release is triggered by fire, such vegetation has likely been consumed, so travel under these conditions will be less restricted.

Growth of the new germinants is slow. The elongating root has difficulty penetrating the litter layer or algal mat and survival is extremely poor unless moisture conditions remain near optimum. Of course, if seed release is prompted by fire, these problems disappear because seed release is coordinated with exposure of a mineral soil seedbed. Because root elongation is slow, the germinants are very susceptible to desiccation. But they can withstand submergence for 1 or 2 months (Myers 1976).

Fire performs a number of functions that help to optimize the chances of successful melaleuca colonization. Depending on intensity, fire triggers seed release, clears the site of competing plant species, consumes the litter which produces a mineral soil seedbed and temporarily fireproofs the area thereby protecting the melaleuca germinants, consumes seed in the litter or on the soil surface, recycles nutrients making them readily available to the newly established seedlings, removes any heat-unstable allelopathic agents in the litter, and protects the tree crowns from another fire for several years by removing the loose bark. If fire occurs during the height of the dry season (March to May), it releases melaleuca seed 5 to 8 months ahead of its major tree competitors, namely south Florida slash pine (*Pinus elliottii* var. *densa*) and cypress (*Taxodium distichum*). Crown fires temporarily halt transpiration so that subsequent rains will keep the soil moist for longer periods of time. Further, destruction of the existing canopy increases sunlight penetration which promotes germination and growth while the standing trunks provide partial shade that moderates soil surface temperatures.

### ***Survival Mechanisms***

Living tissue is killed by exposure to temperatures of 122° to 131°F for several minutes (Ashton 1970; Nelson 1952); cambial temperatures must, therefore, be kept below this threshold to ensure survival. Fire resistance depends primarily on bark thickness (Hare 1965; Vines 1968) and melaleuca has an extremely thick bark (2 to 3 in. or more at maturity) that provides excellent insulation to the cambium. If a fire does kill part of the trunk or crown, that portion which is still alive will send out epicormic sprouts. These sprouts result in a profusion of new branches; the result is often an increase in the seed-bearing capacity of the crown. Basal sprouts will develop whenever a tree is completely topkilled. Even seedlings will sprout once they reach 4 to 5 in. in height. Because of its existing root system, any plant that survives a fire is in an excellent position to capitalize on the fertilization effect of the fire.

Thus, melaleuca has evolved fire adaptations that not only enhance proliferation of the species by showering a receptive seedbed with its own seed, but also by enable existing trees to survive vegetatively. In addition, true fire types have certain characteristics that actually predispose them

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<sup>1</sup> Woodall, Steven. The sources of variation in the viability of melaleuca seed. Manuscript on file. Southeastern Forest Experiment Station, Athens, Georgia.

to fire (Ashton 1970; Mount 1969; Mutch 1970). Both the bark and foliage of melaleuca are structured in a way that increases fire intensity, thereby increasing the probability of topkill in its less fire-resistant competitors.

The outer layers of bark are loosely attached and frayed which gives the trunk a shaggy appearance. They ignite readily, even after a rain, and burn with a black oily smoke. Burning sections of bark are easily separated from the tree by the force of the updrafts, lofted into the smoke plume, and transported downwind where they can start spot fires. Further, this loose outer bark acts as a ladder fuel carrying the fire into the tree crowns. As the fire reaches the canopy, the heat volatilizes the essential oils in the foliage and the crown bursts into flame —again emitting an oily black smoke. If melaleuca tree crowns are in close proximity (and they often are), the fire will spread from crown to crown ahead of the surface fire.

The fact that melaleuca stands are capable of supporting intense crown fires, however, does not mean that they always do. Depending upon weather and fuel conditions, fire behavior can range from a fast-moving crown fire to a gentle backfire barely licking at the lower bole with no attendant seed release. Fortunately, there is a low probability that the combination of weather and fuel necessary to produce a crown fire along with an ignition source will all occur at the same time. The limiting factor currently is the distribution of dense stands of melaleuca; but as the area dominated by this species expands, crown fires will become more common.

## MANAGEMENT IMPLICATIONS

### *Safety Considerations*

With the spread of dense melaleuca stands, a concomitant increase in potential disaster can also be expected. Land clearing before development promotes melaleuca colonization. In a few years, the buildings will be surrounded by a gigantic melaleuca torch waiting to be lit. Examples of this phenomenon are already far too plentiful in parts of Lee and Collier Counties.

The Florida Division of Forestry is acutely aware of this situation and has designated many such areas as special initial attack zones. On most days, the quick response of an aggressive fire control force will prove effective, but under severe burning conditions, fires will be beyond control before arrival of this force, and suppression activities will have to be confined to holding the rear and flanks of the fire (no small job in itself) until the weather or fuels change. The safety of residents and their orderly evacuation will become primary concerns.

The individual homeowner can take effective fire-prevention measures to protect his property as well as learn what to do when an actual fire threatens. A list of suggestions are given in Appendix A.

Although this problem has to date eluded a long-term solution, there are procedures one can follow that will reduce the threat and provide a higher degree of homesite protection. To accomplish this, fire prevention and protection should be discussed with the architect, builder, and local fire control agencies and decisions made during the planning stages of a development (See Appendix B).

### *Control Strategies*

If melaleuca were managed as a desired species, prescribed fire would be the single most important tool available to the resource manager. But, if as is generally the case, the objective is to control melaleuca, the role of fire becomes more ambiguous. Duever et al. (1979), Ewel and Myers (1976), Myers (1975), and Woodall (this symposium) have all suggested methods of control utilizing fire. Prescribed fire to promote seed release just before a period of prolonged drought or flooding, or, a well timed prescribed burn to kill the melaleuca germinants after a hard frost has released the seed, are two suggestions — but they both ignore the problem of mother trees. A control program designed to eradicate both seedlings and seed-bearing trees would be much more desirable. Woodall (this symposium) describes such a program. Briefly, he advocates the use of herbicides to kill existing trees and release the stored seed to be followed by a prescribed fire after the seed germinates to destroy the seedlings.

Because melaleuca is so difficult to eradicate once established, the prudent land manager should prevent its initial encroachment rather than attempt to eliminate it after it has successfully

colonized a site. One way to accomplish this goal is to manage south Florida landscapes in ways that will maintain the vigor of the native vegetation. This in no way suggests that the use of prescribed fire should be stopped. On the contrary, fire is an effective, efficient tool capable of achieving many management objectives when its behavior is regulated by selecting specific fuel and weather conditions under which to burn. But care must be exercised in planning a burn; thickets of melaleuca should be excluded and individual seed-bearing trees should be either raked around or killed to release their seed before the burn. Prescribed fire is the most practical means of keeping fuel accumulations at a tolerable level, thereby minimizing wildfire damage. For example, prescribed fire was authorized on more than 200,000 acres in Collier County, Florida, in 1977 (Wade and Long 1979). To abolish such a practice would set the stage for intense wildfires capable of destroying the native vegetation and creating conditions favorable for melaleuca to take over the site. Wildfires have been an integral part of the south Florida environment for thousands of years. Here, as in other fire climates, and in spite of massive expenditures of tax dollars, the immediate suppression of all fires has not proved to be a viable alternative (Wade, Ewel and Hofstetter 1980). Moreover, fire exclusion — if it were possible to attain — would be self-defeating because it would result in an entirely different set of vegetation responses that may or may not be desirable. Some responses would be irreversible in the long run and all would favor other species over fire-tolerant plants such as south Florida slash pine and cypress. Thus, prescribed fire should continue to be judiciously used to help keep the native vegetation healthy, which, in turn, will help contain the spread of melaleuca.

### *Summary and Conclusions*

Most fire species have made genetic adjustments that ensure survival of existing trees, or promote seed dispersal and the subsequent germination and establishment of a new stand. Melaleuca is such a species, having several fire-evolved adaptations that allow it not only to cope effectively with this natural force, but to flourish under it.

Perhaps the most spectacular trait of melaleuca is its propensity for crown fires, which adds a new dimension to fire suppression in south Florida. Suppression techniques using existing fire control equipment are generally ineffective against crown fires which create the potential for a disaster wherever housing developments and dense stands of melaleuca are intermixed. However, fire prevention and protection measures which range from proper subdivision planning to homeowner action during a fire can do much to protect homes in a wildland environment.

Because melaleuca is fire-tolerant during all but the early seedling stage, control of this species cannot be accomplished by fire unless used in conjunction with other controls such as herbicides. A preferable control strategy is to keep melaleuca from spreading to additional acreage rather than trying to eradicate it once it is established. One practical way to achieve this objective is to manage the native vegetation using prescribed fire as necessary to keep these plant communities healthy and, thus, resistant to melaleuca colonization.

## LITERATURE CITED

- Fire safety considerations for developments in forested areas.  
(n.d.) (Forest Protection Agencies in Oregon and Washington.) 11 p.
- Ashton, D. H.  
1970. The effects of fire on vegetation. Second Fire Ecol. Symp. (Monash Univ., Victoria, Aust., Nov. 1970) 6 p.
- Browder, Joan and Peter Schroeder.  
Seed dispersal. This symposium.
- California Division of Forestry  
1972. Recommendations to solve California's wildland fire problem. Rep. of the Task Force on California's Wildland Fire Problem to Normal B. Livermore, Jr., Resources Agency Secretary, June 1972. 63 p.
- Christensen, P. S.  
1971. Stimulation of seedfall in Karri. Aust. For. 35(3):182-190.

- Colorado State Forest Service.  
1977. Wildfire hazards; guidelines for their prevention in subdivisions and developments. Col. State For. Serv., Col. State Univ., Fort Collins. 7 p.
- Duever, Michael J., John E. Carlson, John F. Meeder, et al.  
1979. Resource inventory and analysis of the Big Cypress National Preserve (Vol. 1). Final Rep. USDI Nat. Park Serv., Homestead, Fla., Contract #CX500070899. Cent. for Wetlands, Univ. Fla., and Ecosystem Res. Unit of Natl. Audubon Soc. 700 p.
- Ewel, J., and R. Myers.  
1976. Assessment of melaleuca distribution and spread. In Studies of vegetation changes in south Florida. Final Rep. USDA For. Serv., Southeast. For. Exp. Stn., Macon, Ga. Subcontract #18-492. p. 72-77.
- Fahnestock, George R.  
1971. Rating forest-fire hazard in residential developments in Colorado forests. Mimeo. Col. State For. Serv., Col. State Univ., Fort Collins. 29 p.
- Hare, Robert C.  
1965. Contribution of bark to fire resistance of southern trees. J. For. 43(4):248-251.
- Meskimen, George F.  
1962. A silvical study of the melaleuca tree in south Florida. M.S. thesis. Univ. Fla., Gainesville. 177 p.
- Mount, A. B.  
1969. Eucalypt ecology as related to fire. Proc. Tall Timbers Fire Ecol. Conf. (Tallahassee, Fla., April 1969) 9:75-108.
- Mutch, Robert W.  
1970. Wildland fires and ecosystems -- a hypothesis. Ecology 51(6):1046-1051.
- Myers, Ronald L.  
1975. The relationship of site conditions to the invading capability of *Melaleuca quinquenervia* in southwest Florida. M.S. thesis. Univ. Fla., Gainesville. 150 p.
- 
1976. Melaleuca field studies. In Studies of vegetation changes in south Florida. Final Rep., USDA For. Serv., Southeast. For. Exp. Stn., Macon, Ga., Subcontract #18-492. p. 4-15.
- Nelson, Ralph M.  
1952. Observations on heat tolerance of southern pine needles. USDA For. Serv. Stn. Pap. 14, Southeast, For. Exp. Stn., Asheville, N.C. 6 p.
- North, D. Warner, Fred L. Offensend, and Charles N. Smart  
1975. Planning wildfire protection for the Santa Monica Mountains: An economic analysis of alternatives. Fire J. 69(1). 6 p. (Reprint).
- Vines, R. G.  
1968. Heat transfer through bark, and the resistance of trees to fire. Aust. J. Bot. 16:499-514.
- Wade, Dale D., John Ewel and Ronald Hofstetter.  
1980. Fire in south Florida ecosystems. USDA For. Serv. Gen. Tech. Rep. SE-17, Southeast. For. Exp. Stn., Asheville, N.C. 125 p.  
and Michael C. Long.
- 
1979. New legislation aids hazard-reduction burning in Florida. J. For. 77(11):725-726.
- Woodall, Steven L.  
Integrated methods for *Melaleuca* control. This symposium.

## APPENDIX A

### HOMESITE WILDFIRE PROTECTION

While wood is sometimes used in the exterior construction of houses in south Florida, building materials have traditionally been cement block, stucco, and tile or cement shingles. But the use of these nonflammable materials does not necessarily fireproof the structure. For example, most houses have exposed or boxed-in eaves of wood which can be ignited if fire gets too close to the walls. In addition, radiant heat can ignite flammables, like curtains, inside the glass. Firebrands can also ignite building interiors by breaking a window, particularly if it has been cracked by the heat. The following list of suggestions for fire-prevention is divided into measures that can be taken by the homeowner before a wildfire occurs and those that can be taken when a home is actually threatened by a wildfire. This list was partially derived from Fire Safety (n.d.), Colorado State Forest Service (1977), Fahnestock (1971), and North et al. (1975).

#### A. *Preplanning*

1. Box in exposed eaves and/or use fireproof paint.
2. Protect large picture windows or glass doors vulnerable to radiant heat from fuel accumulations by using shutters or extremely closesh screen.
3. Use fireproof paint on any wooden window frames and shutters.
4. Use fire-resistant materials for building projections such as balconies and decks.
5. If house is on stilts, screen underside of floor joists.
6. Keep tree branches at least 15 feet away from stovepipes or chimneys.
7. Do not let dead needles, leaves, twigs, etc. accumulate on roofs, sun decks, porches, or in gutters.
8. Remove dense flammable brush from around the immediate vicinity of the house and keep a 10- to 15-foot strip around all structures clear of dead grass and weeds, fallen limbs, household debris, and other fuels.
9. Consider the fire potential of trees and shrubs near the house. Grass fires can light the loose bark of trees, such as eucalyptus and melaleuca, travel up the stem, and ignite the crown with dire consequences to any adjacent building.
10. Make sure the house number is plainly legible from the street.
11. Buy a gasoline-operated pump and hose for fire-fighting purposes if there is a pond or swimming pool on the property. The electricity may be out during a fire, rendering the electric well-pump useless.
12. Plan for fire emergencies by selecting escape routes.
13. Learn rudimentary fire-fighting techniques.

#### B. *When a Fire Threatens*

1. Close all doors, windows, and chimney dampers.
2. Bring in outside furniture.
3. Turn on sprinkler system.
4. Fill bathtubs and sinks with water. Water pressure may be lost during a fire.
5. Place buckets of water near windows and glass doors facing the direction of the fire and douse any fires that start. Radiant heat and firebrands can break windows and ignite interiors, or if fire is intense enough, radiant heat can ignite curtains or other flammable material right through the glass.
6. Thoroughly wet-down all exposed exterior wood such as eaves or eaves boxing.
7. Fuel gasoline-operated pump and hook up hose so swimming pool or pond can be used as a water source if necessary.

## APPENDIX B

### PLANNING FIRE SAFETY FOR DEVELOPMENTS

These suggestions are from Fire Safety (n.d.), Colorado State Forest Service (1977), and Fahnestock (1971). More detailed recommendations, including implementation procedures, can be found in California Division of Forestry (1972). All of these publications pertain to the western United States where the destruction of forested developments and urban subdivisions is an all too common occurrence. To date, such a disaster has not happened in south Florida, but as stands of melaleuca and urban sprawl continue to intermingle the probability of such a disaster steadily increases.

Safety measures that cover vegetation management, traffic flow, and water supply should be addressed during the planning stage of developments.

#### A. *Vegetation Management*

1. Develop hazard classes for vegetation based on expected fire behavior. Modification of fuels in high-hazard classes will be necessary before construction can begin.
2. Determine a lot size and building placement that will accommodate an adequate fuel break within the limits of an owner's lot.
3. Establish a fuel break around subdivisions or developments in forested areas. The width of the fuel break should be determined by the local fire authority, but at least a 100-foot width is recommended.
4. Clear all flammable material (living and dead) from road rights-of-way and dispose of debris before construction begins.

#### B. *Traffic Flow*

1. Allow for at least two different ingress-egress routes. Loop drives with a single entrance will not suffice.
2. All subdivision roads and easements, including fire access lanes, but excluding private driveways, should be dedicated to the public in perpetuity. All subdivision lots should abut a public road.
3. All dedicated roads should have at least a 60-foot right-of-way, including a minimum 34-foot all-weather roadbed.
4. No dedicated road should have a centerline radius or curvature less than 80 feet.
5. Cul-de-sacs should be limited to 750 feet in length and terminate in a turn-around right-of-way at least 90 feet in diameter.
6. Dead-end streets (not cul-de-sacs) should not be allowed.
7. Stub roads should end in a turn-around until such time as the road is connected. Turn-around requirements should be the same as for cul-de-sacs.
8. All road and road-driveway intersections should be greater than 45 degrees.
9. Any bridges should be constructed to support a gross vehicle weight of at least 26,000 pounds.
10. Road names should not duplicate other existing or proposed road names within the county. Permanent road signs of durable materials should be installed at all intersections.

#### C. *Water Supply*

1. If a fire hydrant system is used, it should meet the current National Fire Protection Association standards, with hydrants installed not more than 1,000 feet apart and fully charged with water before approval of the final plot is given. An acceptable alternative is the strategic location of metal or concrete water cisterns with a minimum capacity per cistern of 100 gallons per acre protected or 500 gallons per dwelling unit, whichever is more.
2. Water supply mains for single-family dwellings should be at least 1 inch in diameter. Garden hose outlets should be plumbed at least 50 feet from buildings to provide for hose-stream protection for all sides and the roof of the building. Home water systems should have a generating pressure of 50 pounds per square inch.